

Inside the KNIGHT



The KNIGHT Heating Boiler is available in five models from 80,000 to 285,000 Btu/Hr and has many significant advantages over other condensing boilers on the market today. KNIGHT Heating Boilers are 93% AFUE. When used in a low temperature radiant heating application, efficiency is further increased to 98%. This training document will examine numerous features that give the KNIGHT Heating Boiler its distinct competitive advantage.

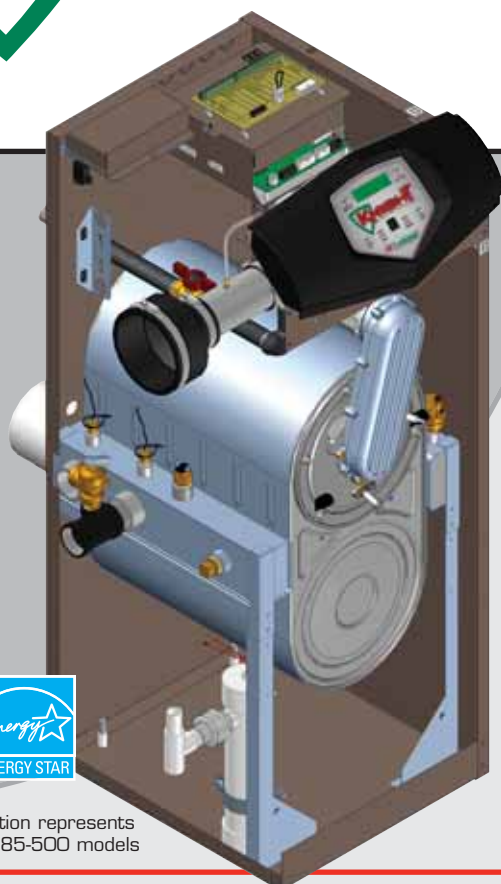


Illustration represents
KBN 285-500 models

The Jacket

The KNIGHT Heating Boiler is an appliance that compliments the house. Refrigerators, stoves and dishwashers hold this distinction; and yes, even water heaters are starting to. So why not your major heating appliance? Contractors today take great pride in the appearance of piping and control systems used in residential heating. Why shouldn't the boiler be appealing as well? The KNIGHT Heating Boiler uses a sculpted steel jacket which gives the contractor the ability to provide their customer with a professional installation.

The jacket is not an integral part of creating the sealed combustion aspect of this appliance. The KNIGHT Heating Boiler uses a direct air intake connection to the combustion air inlet fan. This eliminates the need of a sealed outer jacket assembly and makes service to the boiler much easier.

The rear of the jacket is also contractor friendly. The KNIGHT Heating Boiler provides 8 conduit knockouts for field wiring connections and direct connection to the flue outlet of the appliance.

Leveling legs are provided as standard equipment allowing for a professional, clean installation on uneven floors. Panel removal for service and setup is made easier with the KNIGHT Heating Boiler jacket. The top and front panels utilize snap pins that hold them firmly in place. To access the interior, simply pull the panels off by hand.

The Combustion System

The KNIGHT Heating Boiler uses a sophisticated air/fuel delivery system commonly referred to in the industry as a "Negative Regulation" (Neg/Reg) arrangement. The speed of the fan constantly adjusts the volume of fuel and air drawn into the burner. The faster the fan speed the greater the negative pressure it creates; the greater the negative pressure, the more fuel is drawn into the burner. The speed of the fan is directly controlled by the SMART SYSTEM control. The SMART SYSTEM sends an electrical signal to the fan enabling it to change speed. The electrical signal is of a "Pulse Width Modulation" (PWM) type. In turn, the KNIGHT Heating Boiler is capable of a 5:1 turndown firing rate.

The Neg/Reg combustion system also allows the KNIGHT Heating Boiler to safely and reliably operate with supply gas pressure as low as 4" w.c. This is a clear advantage when working with older homes in a retrofit application or in the mountain areas of the United States. A Natural to LP gas conversion kit is standard with all models.

The Ignition System

The KNIGHT Heating Boiler uses "direct spark ignition." Direct spark ignition utilizes two electrodes to create an ignition point. After a call for heat, the SMART SYSTEM sends a high voltage electrical pulse to one of the

electrodes; the electrical pulse will then ground itself to the second electrode creating a spark. The spark is responsible for igniting the air/fuel mixture. A third electrode will then sense the flame through flame rectification. If no flame is detected, the SMART SYSTEM will reset and attempt ignition again for a total of 4 times. If no flame is sensed after these attempts, the SMART SYSTEM will lock out and display the fault.

The Burner

The burner used in the KNIGHT Heating Boiler is 411 stainless steel. The burner is in a 360 degree configuration and covers the entire length of the primary heat exchanger allowing for substantial reduction in the overall size of the appliance. Units that utilize multiple burners are generally much larger in size.

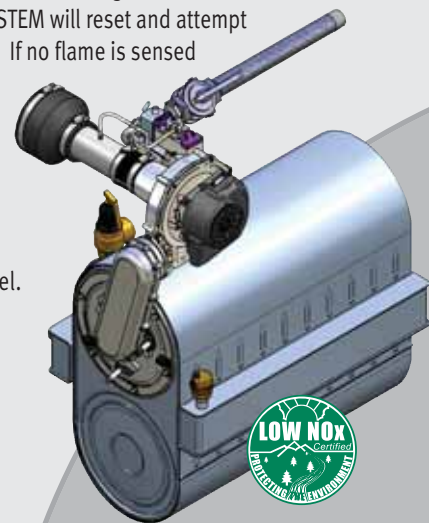


Illustration represents KBN 285
model combustion system



The Heat Exchanger

The KNIGHT Heating Boiler's heat exchanger is an advanced design. Its construction is of 316L stainless steel tubes, headers and casing. Stainless steel heat exchangers perform without constant monitoring of the system pH. The tubes are welded into headers eliminating the need for any gaskets or O-rings. The tubes are oblong and formed utilizing an advanced hydro forming process. Hydro forming uses pressurized water exceeding 10,000 psi to alter the shape of the stainless steel tube. This easily creates the desired tube shape.

The heat exchanger appears to be one single unit when it is in fact two heat exchangers in one - the primary heat exchanger, which is exposed to the burner flame; and a secondary heat exchanger, which is only exposed to the flue gas. The KNIGHT Heating Boiler is a condensing boiler that allows condensation to occur only on the secondary portion of the heat exchanger. This design allows for entering water temperatures to be as low as 50°F thus eliminating worry of damage to the primary heat exchanger.

The heat exchanger is ASME Section IV approved and is marked with an "H" stamp indicating ASME compliance. ASME approval for a pressure vessel is important. ASME ensures the user and installer of the highest quality in design and materials possible for the heat exchanger.

Effective January 2006 all ANSI Z21.13 certified boilers MUST carry an "H" stamp.

Venting

The KNIGHT Heating Boiler is certified as a Direct Vent appliance. This approval allows the KNIGHT to use PVC for exhaust venting and air intake. The KNIGHT Boiler will allow for up to 100 feet of air intake pipe and 100 feet of flue gas exhaust. Foam core PVC should never be used for the flue gas exhaust. The KNIGHT Boiler should be installed with schedule 40 PVC or CPVC. Common industry codes and practice should always be followed when installing and terminating the air intake and flue gas exhaust. For difficult or space restrictive installations, a concentric vent termination is available as an option for the intake and exhaust for models up to 285,000 Btu/hr.

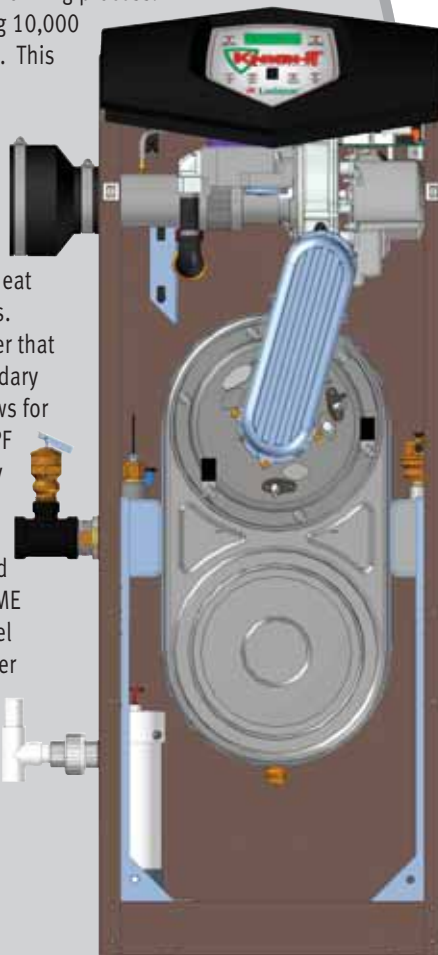
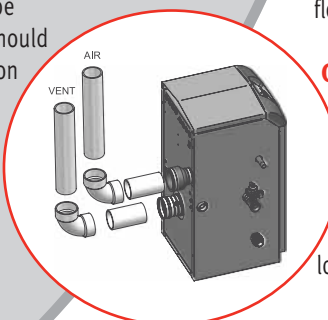


Illustration represents KBN 285 models



The SMART SYSTEM™ Control

SMART SYSTEM is truly the marquee item of this appliance. Operation is simple to understand and doesn't require special training or certification. SMART SYSTEM is extremely user friendly, and has the capability of diagnostics from the front of the boiler or through simple PC or Pocket PC software.

A few of the basic functions of the SMART SYSTEM CONTROL are:



5:1 Burner Turn Down- SMART SYSTEM is set to allow modulation of the burner down to 20% of maximum input. This range of modulation allows the KNIGHT Heating Boiler to match load requirements of the installation. With this degree of load matching, energy consumption is minimized under all conditions.

2 Line, 16 Character Display- Diagnostics and set-up become much simpler. The size and characteristics of the display allow for actual words to be shown.

2 Levels of Password Security- SMART SYSTEM allows for the programming of a user password and an installer password. This prevents any unauthorized tampering of the appliance settings.

Product Service Indicator- The installer can initiate this at the display. The indicator can be programmed to display based on number of cycles, hours of operation, or time since last service.

Pump Relay w/ Freeze Protection- SMART SYSTEM will monitor boiler water temperature to ensure that if the temperature falls below 40°F the pump will start forcing circulation of the water. If the water temperature continues to drop to 35°F the unit will fire the burner until the water temperature is raised to 40°F.

Low Water Flow Indication- SMART SYSTEM monitors change in temperature through the heat exchanger. If the difference is large enough, the module will reduce the modulation rate and shut the boiler down on temperature. However, this should not be used as a safety device. A low water cut-off or flow switch should be used for true low water protection.

Outdoor Reset- The KNIGHT Heating Boiler includes a sensor to monitor outdoor air temperature. This is standard and does not require the purchase of an option. The outdoor sensor, when attached to the SMART SYSTEM, will allow the boiler to operate on a reset schedule. The reset schedule maintains the boiler water temperature to precisely meet the load requirements of the installation.

DHWP w/ Pump Control- SMART SYSTEM allows for direct connection to an indirect tank to meet potable hot water requirements. The indirect tank thermostat will send a signal to the SMART SYSTEM indicating a call for domestic hot water. SMART SYSTEM will then override the outdoor air reset and start the DHWP pump to flow boiler water to the coil in the indirect tank. SMART SYSTEM drives both the firing rate and boiler discharge water temperature to the setting determined by the installer, allowing for a fast recovery of domestic hot water loads. The installer can also adjust the amount of time the boiler operates in an override setting, and the time the DHWP pump is allowed to operate after demand is satisfied.

Contacts on Any Failure- This allows for connection of an audible alarm in the event of a boiler fault or will send an alarm signal to a BMS.

System Pump Control- SMART SYSTEM will supply power to, and operate, the system pump as needed. The installer can vary the amount of time the system pump is allowed to operate after a call for heat has been satisfied.

Boiler Pump Control- SMART SYSTEM will start and stop the boiler pump as needed and allows the installer to set the amount of time the pump is allowed to operate after the call for heat is satisfied.

Inlet and Outlet Water Temperature Sensors- SMART SYSTEM will display inlet and outlet water temperatures, and allow the installer to determine which sensor will be used to control the boiler set point.

F or C- Allows the installer to set the unit to display degrees Fahrenheit or Celsius.

Boiler Set Point- SMART SYSTEM allows the boiler set point to be adjusted by the user. The installer can program the minimum and maximum set point parameters that the user will be allowed to adjust.

Off Time Limiting- SMART SYSTEM allows the installer to determine, in time, how long the unit must remain off prior to allowing a new firing sequence to begin. The installer may also program the limit to override if the water temperature drops significantly prior to the completion of the limiting time.

Building Management System (BMS) Control- The installer can program the control to accept a 0-10 VDC external signal. The BMS settings are: set point at low/high input, low/high input range, BMS power setting at low/high range and the BMS differential temperature setting. In order to program SMART SYSTEM to accept the BMS signal, setup must be performed with the optional PC software kit.

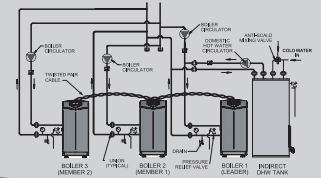
Night Setback- SMART SYSTEM allows the installer to program a temperature setback for any time in a 24 hour day, for each day of the week.

Service Mode- SMART SYSTEM includes a masked button that allows the boiler to be put into a temporary service mode. This button allows manual control of the blower speed. SMART SYSTEM will automatically return to normal operation after a timeout if no buttons have been pushed.

The previous list gives a brief description of the functionality of the SMART SYSTEM control. The KNIGHT Heating Boiler Installation and Operation or Service manual should be consulted for complete instruction to adjust any of these settings and features.

"Built-In" Cascading Sequencer

An internal sequencer is standard on each KNIGHT and allows for lead/lag sequencing of up to eight boilers. The lead/lag configuration rotates the lead boiler after a 24 hour time period to ensure equal runtime for all boilers. Since the sequencer is built into the KNIGHT, there is no need for an expensive third party sequencing control.



PC and Pocket PC Connection

The KNIGHT Heating Boiler is available with PC software and hardware to troubleshoot and program all functionality or Pocket PC software with infrared technology.

The software also allows for easy plotting and trending of historical data. The data can be used to determine many points of reference including approximate energy consumption. It is necessary to purchase the PC software and hardware to install and program Building Management System features into SMART SYSTEM.

Field Connection Provisions

The KNIGHT Heating Boiler's field wiring connections are extensive. The user friendly terminal strip provided with all KNIGHT Heating Boilers allows for 28 points of low voltage field connections. These connections may be additional safeties or accessories. The KNIGHT Heating Boiler also provides for 4 line voltage connections. Line voltage connections are for power supplied to the unit, and power distribution for up to three pumps operated by the SMART SYSTEM Control.

Field Low Voltage Connections

A 24 VAC Pilot Supply- This will provide a 24 VAC signal during a call for heat. This connection is commonly used to close a relay which in turn supplies power to an auxiliary device such as a mechanical room fan.

Gas Pressure Switch- These connections allow for the addition of low or high gas pressure safety switches, which are required in many areas of the country.

Flow Switch- Connection points used for flow sensing with a paddle type flow switch.

Alarm Contacts- Provides a contact closure in the event of any failure to the unit. Generally this would be connected to an audible alarm or BMS.

Runtime Contacts- Contact closure when unit is on.

R/W Tank Aquastat Connection- Allows for the connection of a thermostat to control the DHW indirect tank.

LWCO Connection- Specialized connection point for the LWCO provided by Lochinvar.

R/W Room Thermostat Connection- For room thermostat or zone control installation.

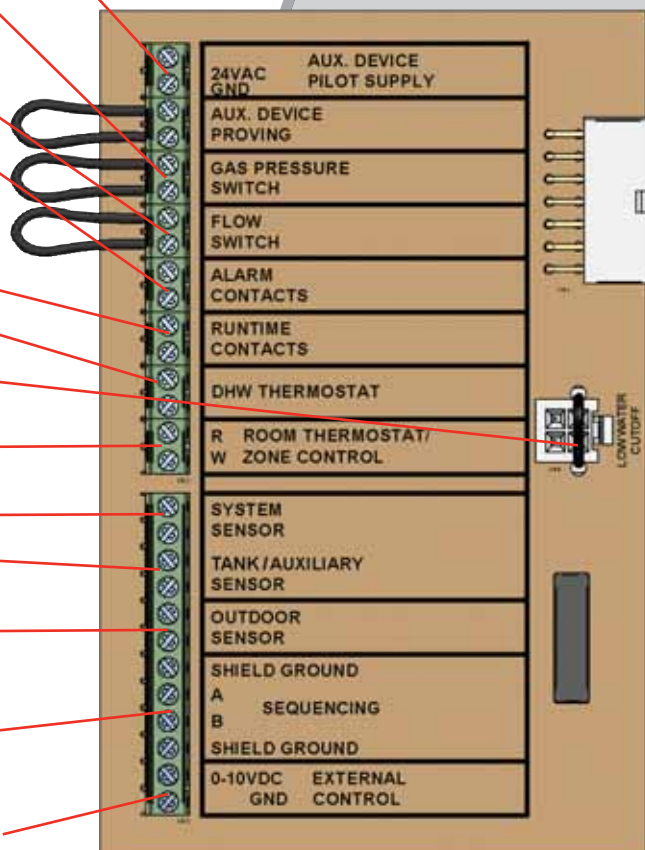
System Sensor- Used for multiple boiler systems.

Tank/Auxiliary Sensor- The DHW tank sensor allows the Smart System control to maintain the stored water temperature.

Outdoor Sensor- The outdoor air sensor, when connected, allows the boiler to maintain a water temperature based on outdoor conditions. The SMART SYSTEM will automatically detect when an outdoor air sensor is connected.

Cascade Sequencing These connections allow up to 8 individual units to be "daisy chained" together to provide for sequenced operation under the control of a single "leader" boiler.

0-10 VDC External Control- Allows the contractor to tie an external temperature control such as a sequencer or Building Management System to the boiler to control modulation rate or temperature set point.



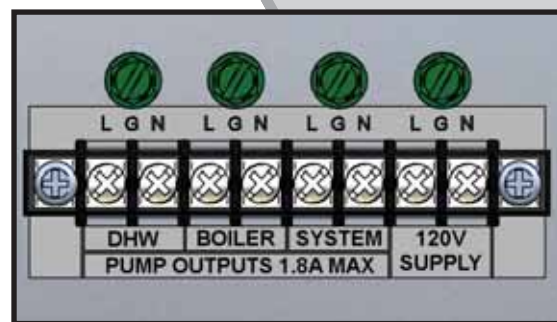
Field Line High Voltage Connections

Boiler Pump- This connection must be used to provide 120 VAC to the pump provided with the KNIGHT Heating Boiler.

System Pump- The KNIGHT Heating Boiler performs optimally when installed in a primary/secondary piping arrangement. With primary/secondary, a system pump is required.

DHW Pump- When installed and connected to a domestic hot water prioritization arrangement, these contacts are used to start and stop the pump moving hot water through an indirect tank.

120 VAC Supply- This connection is the power supply to the boiler. Always install the electrical supply to the KNIGHT Heating Boiler in a hard wired configuration. Never use extension cords to supply power.



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Lochinvar Corporation • 300 Maddox Simpson Pkwy • Lebanon, TN 37090 • 615-889-8900 / Fax: 615-547-1000

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